19.4

Nucleus pulposus regeneration using fresh autologous adipose-derived cells

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Purpose: Adipose-derived stem and regenerative cells (ADRCs) differentiate into a nucleus pulposus-like phenotype when exposed to in vivo environmental factors. A study was initiated to evaluate whether autologous cells derived from adipose tissue would be effective in an established dog model for acute disc injury.
Methods and Materials: Adipose tissue was harvested in 4 adult dogs (25-30 kg) from the thigh and ADRCs were collected from the tissue using enzymatic digestion and cell concentration. Nucleotomy was performed on three levels. One million cells were suspended in either (a) hyaluronic acid (HA) or (b) saline, and placed centrally into two of the three levels. MRI was performed on all four dogs at six and twelve weeks. Dogs were euthanized at six and twelve weeks, following the placement of the cells. Radiographic anatomy, MRI, histology and gross pathology were used to assess the outcomes of the intervention.
Results: Disc levels receiving cells with HA carrier had thicker discs, a higher cell content with better organized colonies of cells, more matrix production compared to the levels receiving cells with a saline carrier. Levels that had only nucleotomy lacked significant regeneration of matrix.
Conclusions: This feasibility study provides evidence that ADRCs can be transplanted at the time of surgery and injected safely by percutaneous means. Coupled with encouraging results described here, plus other clinical studies using autologous disc chondrocyte transplantation, this project has now been extended to include six-month and one-year assessments of ADRCs injected with an HA carrier.

19.5

The morphology and effect of meniscus regrowth

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Purpose: Evaluation of the occurrence and morphology of meniscus regrowth after complete medial removal of the meniscus and its effect on the hyaline articular cartilage
Methods and Materials: 32 NZW rabbits were used according to a protocol permitted by both, the Institutional and the Governmental Ethics Committee. All animals were male and skeletally mature as checked by standard x-ray. An open medial parapatellar approach was performed under sterile conditions. The medial meniscus was completely excised from the synovial junction. Particular care was taken at the posterior horn for complete separation from all meniscus attachments. 8 animals each were sacrificed at 2, 4, 8 and 12 weeks. Macroscopic grading was performed in accordance with the ICRS grading system, microscopic grading following a modified Mankin`s scheme.
Results: The occurrence of a macroscopically well identifiable regrowth was: n = 0 at 2 weeks, n = 4 at 4 weeks, n = 7 at 8 weeks and n = 4 at 12 weeks. The medial menisci grew preferentially at either the anterior horn, body or posterior horn while an even regrowth was unusual. Throughout the study course, only 2/15 regrown menisci were more than 20% width of the original size. A cartilage preserving effect as checked by the joint score or the microscopic score was not observed.
Conclusions: Meniscus regrowth is a well recognised phenomenon. A very variable occurence has been reported in the literature. This study with a duration of up to 12 weeks could not demonstrate an articular cartilage preserving effect by regrowth in this rabbit model.

19.6

Novel Nano-Composite biomaterial for ostheocondral tissue engineering.

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Purpose: The objective of this randomized controlled animal study was to test performance of a newly developed type-I collagen-hydroxyapatite (HA) nanostructural bio-mimetic osteochondral (O.C.) scaffold which reproduces cartilage-subchondral bone morphology.
Methods and Materials: A gradient composite O.C. scaffold, based on type-I collagen-HA, was obtained by nucleating collagen fibrils with hydroxyapatite nanoparticles at physiological conditions. After medial arthrotomy of right hind-paw and condyle exposure, a bi-lateral osteochondral lesion, 7mm diameter and 10 mm deep, was induced in 20 sheep until bleeding appeared. Animals were assigned to five treatment groups: scaffold alone, scaffold loaded with autologous platelet-rich plasma, scaffold cultured in-vitro with autologous chondrocytes, scaffold loaded with autologous (freshly-digested) chondrocyte suspension and empty defect (control). Six months after surgery, animals were evaluated for gross observations, histology and radiographic images for osteo-integration.
Results: Gross evaluation and histology of specimens exhibited good integration of the chondral surface for all groups except for control group where chondral healing appeared fibrocartilage-like. Significantly better bone regeneration was observed in the group with the scaffold alone and the scaffold loaded with autologous chondrocytes. No difference in cartilage bone-surface reconstruction and in the filling of bone and cartilage defect was noted between groups.Microradiography images showed improvement in subchondral bone healing when compared to the control. No bone growth into the chondral layer was observed for all groups.
Conclusions: The results of the present study demonstrated that this novel O.C. scaffold may act as a suitable matrix facilitating regeneration of hyaline-like cartilage. Free Scaffolds and Scaffolds seeded with autologous chondrocytes seemed to demonstrate most promising results.